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Development of the Carr Fork Project

Anaconda's Carr Fork project is located in the Bingham mining district of Utah about 25 miles southwest of Salt Lake City. Pine Canyon, the site of the surface facilities, is adjacent to Kennecott's Bingham Canyon mine, which is about a mile to the east over the crest of the Oquirrh Mountains.

Before examining the mine, let's take a brief look at the geological setting. The Bingham district represents one of America's largest copper resources. Ore at Carr Fork, which is only a portion of the district, consists entirely of skarn mineralization lying adjacent to the Bingham instrusive. This kind of relationship is not uncommon to porpyhry copper deposits in the American west.

The Carr Fork skarns were formed preferentially in two limestone units, called the Yampa and the Highland Boy, which each average about 45 m in thickness and which are separated by about 75 m of quartzite. Copper mineralization consists almost entirely of chalcopyrite associated with pyrite and molybdenite in a gangue of garnet, diopside, magnetite, quartz and carbonate. Gold and silver will be by-products in the copper concentrate and later, as the lower portion of the deposit is developed, we plan to recover molybdenum.

$217 million appropriated for project

On Sept. 6, 1974, after six years of geological evaluation and a year's work assessing feasibility, the Anaconda board approved appropriation of $200 million to develop the Carr Fork mine. This amount was later increased by $17 million as a result of the impact of deferring sinking of the production and fresh air shafts because of capital constraints experienced in 1975. The operation is planned to treat 3,240,000 metric tons (mt) of ore per year and to produce about 50,000 mt of copper per year.

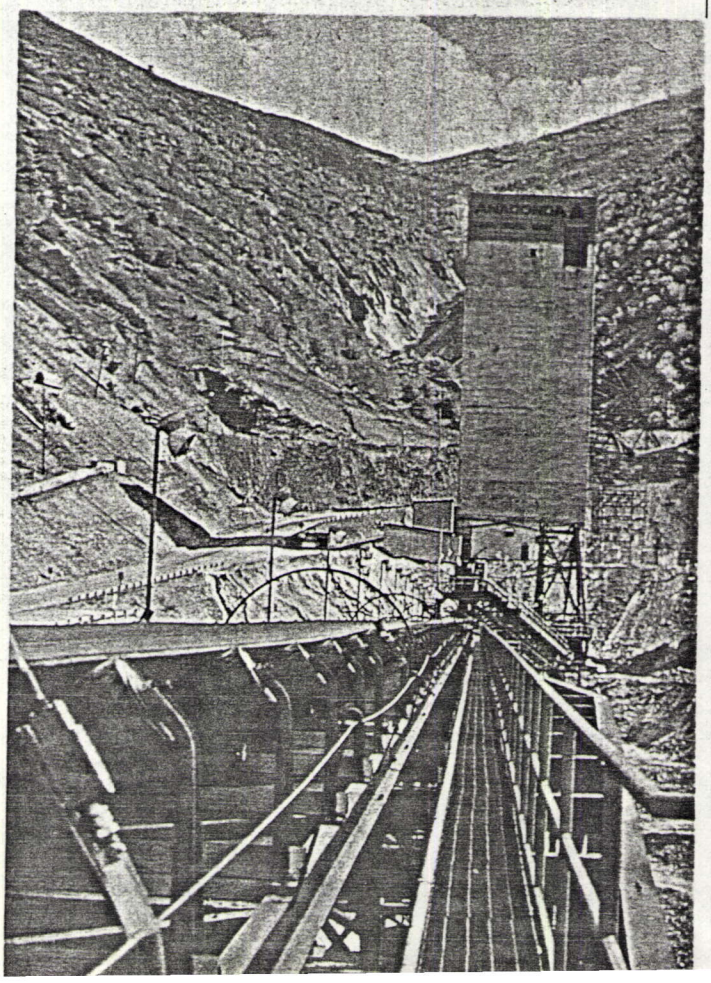
Terrain and property boundaries introduced complications to access and development of the mine and infrastructure. For example, mentally picturing an east-west cross section through the Oquirrh range, the Carr Fork mine ore bodies are at the east end of the property and slightly west of the Bingham pit. About 2 km west of our ore bodies is our production shaft, a 5.8-m diam concrete-lined facility which is 1153 m deep. It will hoist ore and waste and also remove exhaust air from the underground crushing system. It is equipped with four 13½-mt skips and with two 3100-hp friction hoists. The system is capable of hoisting 1050 mtph and the operating format is to hoist 16 hours per day 5 days per week.

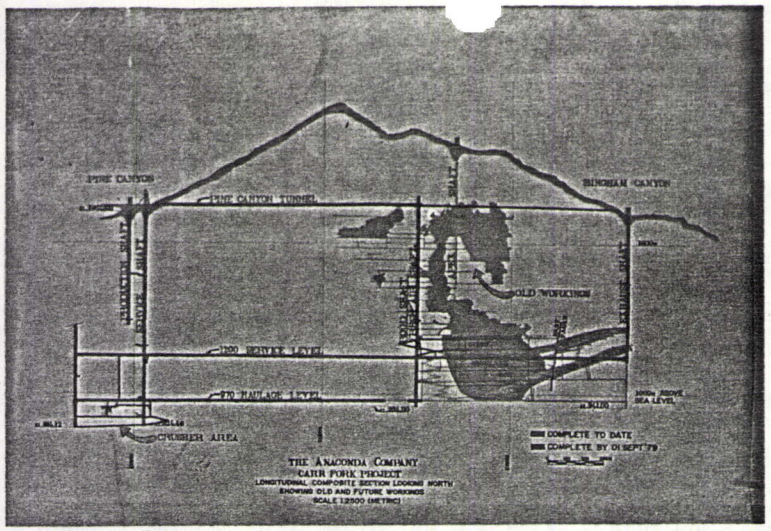
The adjacent service shaft, which is the same diameter as the production shaft and which is 1172 m deep, will handle all routine men and materials movements in and out of the mine. It will also incast about 100,000 cu m per minute of ventilating air. This shaft, equipped with a 6000-hp double-drum hoist capable of a 900 m per minute rope speed, played an important rock-hoisting role during shaft sinking and development of the mine. Except for a manway, the shaft is a single compartment equipped with a two-deck cage that is 5½ m long and 3 m wide and capable of carrying 150 people at a time.

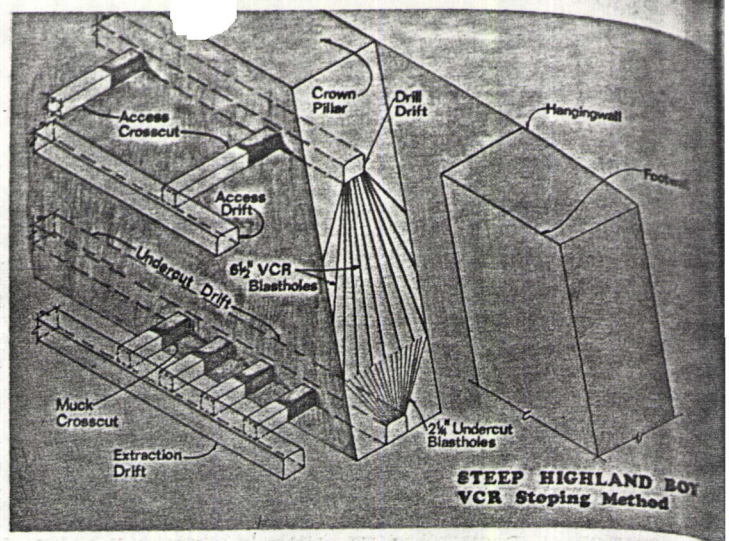
Intake air shaft is internal

Our third shaft, which is internal and connected to surface by two 5 by 5-m tunnels, is part of the principal fresh air route into the mine. It is 5.5 m in diameter and 1065 m deep, and it will ultimately carry nearly 765,000 cu m per minute of ventilating air. It will also serve as our second exit from the mine.

The Carr Fork operation is planned to produce about 50,000 metric tons of copper per year from 3.24 million metric tons of ore. Shown here is the production shaft headframe viewed from along the coarse ore storage transfer conveyor







During development, this shaft played a key role in dewatering old workings which contained nearly 11 billion liters of reservoir. It was also important in staging development of our 1300 and 970 levels.

At the eastern limit, we have a 6.7-m diam exhaust shaft which is also concrete lined and which is intended to remove all exhausted air from mine workings. Ultimate flow will approach 900,000 cu m per minute.

Men and materials adjacent to mining areas are moved using diesel-powered equipment. Ramp systems at a nominal 15 percent gradient service the levels and draw areas. In the mining zones, all development and production rock is loaded and hauled using 3.8 cu m diesel-powered load-haul-dump units. The 1200 level is rail equipped and is the service level for development and mining of the steep limb ore body. It will also carry initial ore production until the 970 level is completed.

Once the 970 level is completed, it will provide rail haulage for transporting all ore and waste from the mining area to the crusher dump. Rock reporting to this level will be transferred from the mining areas via a series of bored raises. Rock haulage on the 970 level will be an electrified push-pull system using 30-ton locomotives and 12-cu m cars. Each train will have a locomotive on either end and consist of a maximum 18 cars. The cars are a bottom-dump variety.

At the dump, trains will be discharged into a 600-mt surge bin ahead of the gyratory crusher. Mine run material is mechanically fed to the crusher which was selected for reduction ratio rather than throughput. Discharge from the crusher is conveyed to either of three 2250-mt crushed-ore bins. Material is mechanically reclaimed from these bins on demand of the production shaft skip loading system.

Ore contains 1.85 percent copper

Let's now look at our intended mining method. Recoverable reserves at the time we made the feasibility study were 55 million mt with an average production grade of 1.85 percent copper. This reserve consists of a steep limb area which dips approximately 80° to the north and the inclined Highland Boy and Yampa beds which vary in dip from approximately 20° to nearly 45° to the northwest.

Our mining method will be variations of sublevel blasthole techniques. In the steep limb area, at the drill horizon we have a footwall service drift with crosscut connections to a drill drift located in the ore. Downholes in vertical fans will be drilled from these drifts. Some 65 m below on the draw level, there is a footwall extraction drift with draw points connecting to the undercut drift from which, at least initially, we will drill fanned upholes to form the undercut. Downholes are drilled using DTH drilling equipment capable of 16.5-cm diam holes. The 6.3-cm upholes will be drilled with a fan drill.

The blasting technique we plan to employ is known as vertical crater retreat. After removing the undercut, we will blast the large diameter holes (16.5 cm diam) retreating in stages from the bottom up.

In the steep limb, the initial stopes are planned to be 48 m on strike with intervening pillars of 24 m or less. Mining of the inclined ore will utilize essentially the same techniques as used for the steep limb. However, we will leave pillars in only those areas where subsidence could affect other mining activity, such as the steep limb, or where facilities could be damaged, such as the exhaust shaft. Where we can mine without pillars, the plan will be to retreat on strike and induce hanging wall cave behind the retreating face. Narrow strike pillars designed to fail will be utilized to prevent premature waste flooding of draw points. An important objective of our mining plan is to achieve good productivity by stressing mechanization and utilization of manpower in ways that do not demand the all-around skills in the sense of a traditional miner.

Process plant is single-line, 9000 mtpd facility

Bechtel was awarded the engineering for a single-line 9000-mtpd plant and later was given the construction management of the plant and related infrastructure. By June 30, 1979 the processing plant was essentially complete.

The difference in elevation from one end of the project to the other end is almost 460 meters and the distance between these two points is approximately 5.6 km. The project facilities have been located on nine major benches descending along Pine Canyon from the service shaft site to the tailing thickeners. A two-lane paved road runs up the canyon to provide access to these facilities.

The Carr Fork flowsheet is straightforward. Minus 13-cm mine crushed ore is conveyed to an open stock-

pile with a total capacity of 118,0 ι, of which 18,000 mt will be "live." Ore is reclaimed by gravity from the orepile by three apron feeders and conveyed to the fine ore crushing plant and reduced to minus 1.1 cm. The fine ore crushing plant is equipped with one 7-ft standard cone crusher, two 8-by-20-ft double-deck screens, and two 7-ft Shorthead cone crushers. Shorthead crusher product joins screen undersize and is conveyed by a 36-in. belt conveyor, approximately 885 m down canyon, to a covered 27,000-mt fine ore stockpile.

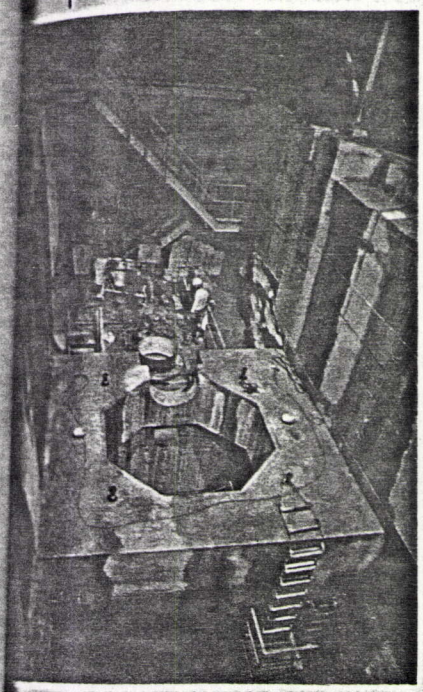
The long downhill fine ore stockpile feed conveyor is powered by a 250-hp regenerative d-c drive and features adjustable speed acceleration and deceleration. Ore is reclaimed by gravity from the fine ore stockpile using three belt feeders and conveyed to the concentrator grinding bay for grinding and classification. Primary grinding equipment consists of one 14-ft diam by 20-ft rod mill and one 16½ ft diam by 29-ft ball mill in closed circuit with seven 26-in. diam cyclone classifiers. Horsepower is 2000 for the rod mill and 5000 for the ball mill.

Flotation cells have 500 cu ft capacity

The minus 100-mesh cyclone overflow gravitates to rougher flotation. Tailing from the seventeen 500-cu ft rougher flotation is deslimed in three 26-in. cyclones. Cyclone underflow gravitates to five 500-cu ft sand flotation cells which produce a sand concentrate and a sand tailing. Rougher flotation concentrate and sand concentrate are pumped to four 15-in. diam cyclones in closed circuit with two 9½-ft diam by 15-ft regrind mills each driven by a 600-hp motor. Regrind cyclone overflow at 90 percent minus 325 mesh gravitates to cleaner flotation consisting of twelve 300-cu ft cells; 4 cleaner, 2 recleaner and 6 scavenger.

Concentrates produced gravitate to a sump for sampling before reporting to a single 125-ft diam concentrate thickener. Concentrate thickener underflow is pumped to two 20-ft diam by 20-ft high storage tanks and the slurry is dewatered in two 12-ft diam by 18-ft long drum string discharge filters. The filter cake is conveyed to a covered 1800-mt stockpile. Stockpile concentrates will be loaded on trucks and delivered to a railroad siding for rail delivery to our smelter in Montana.

Final tailing from the Carr Fork concentrator consists of the desliming cyclone overflow, the sand flotation tailing and the scavenger flotation tails. These three streams are combined and sampled before gravitating to the two 225-ft diam tailing thickeners. Thickener underflows gravity feed an 18-in. diam bell-and-spigot con-



An important objective of the mining plan is to achieve good productivity by stressing mechanization and utilization of manpower in ways that do not demand the all around skills in the sense of a traditional miner. Pictured here are construction on the underground crusher chamber (Left), Haaglund loader (Below), fan drill (Right), LHD (Bottom) and a raise boring unit (Bottom Right.)